EXPERIMENTAL PHILOSOPHY

ASSERTED and DEFENDED,

AGAINST

Some late Attempts to undermine it.

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G.RAIIL
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BR. MUS.

Experimental Philoſophy

ASSERTED, &c.

ONE of the greateſt Obſtacles to the ſpreading uſeful Knowledge, and receiving Information from each other, is owing to a Fault which moſt People are apt to ſlide into, of looking at themſelves, not thoſe they converſe with. When we hear any Thing propoſed, we conſider whether it be agreeable to our own prior Sentiments, not whether it be right or wrong; by this Means not judging of it by its Evidence, but comparing it with thoſe Notions we have already imbibed. If I would ſee an Object in the Light another doth, I muſt put myſelf in the ſame Line he ſtands in, or elſe it is impoſſible I ſhould ſee it in the ſame Point of View, without which it is impoſſible I ſhould judge whether his Obſervations on it are right or wrong. We ſhould therefore place ourſelves in the Line we are directed, though at the ſame Time we may be perſuaded that our own Point of View is the beſt; by which Means we ſhall be able to judge whether it is ſo or no.

So to give another's Argument its due Weight, we ought to lay aſide all we think ourſelves on the Subject, and confine our

Views entirely to what is before us ; not to diſcard our own Opinion, which is neither better nor worſe, nor any Ways affected by this ſeeming Preference which is given to the new Gueſt, but only that we may be able to judge whether it be worth receiving or no. In ſhort, every Man whilſt he is hearing another explaining his Sentiments, or reading his Writings, ſhould act the *School-Boy*, implicitely for the Time acquieſce, as if he knew nothing of the Subject he is upon ; then he will ſee the whole of what is laid before him, and may afterwards call over again every Particular, try it by his own Præcognita, ſet the old Evidence againſt the new, and give it a fair Trial.

This is what I would deſire of the Reader, to lay aſide *ſelf*, and conſider and view Things in the Light I have put them, without rejecting what I ſay, merely becauſe it may not be the ſame, or becauſe it may contradict what, he thought before.

Philoſophy is a Thing of Conſequence, becauſe on the Knowledge of Nature, or of the Laws and Effects of the natural Agents, depends the Knowledge of the Creator, and the only Means of our forming true and diſtinct Ideas or Repreſentations of ſpiritual Objects, whether uncreated or the created ones ; all our Ideas being derived from Senſe, as ſome happily and with great Aſſiduity have maintained of late.

Thoſe who at preſent are, or not long ſince were, in Poſſeſſion of this Source of all Knowledge, have only nick-named the *Effects*, and by a Slight of Hand paſſed thoſe Nick-names upon us for the Agents. Sympathy and Antipathy, or Attraction and Repulſion, the firſt derived from the *Greek* Tongue, the other from the *Latin*, are the ſame, and may well enough ſtand for the Phænomena, or *Effects* of Nature, but are not *Agents*. The grand Queſtion then is by *what* or *whom*, and in what Manner theſe Effects are performed.

That *Matter* is in itſelf iners, incapable of moving or exerting any active Power, unleſs mechanically, can hardly be denied. The Queſtion then is, what is the MOVER, where are we to look for the *Agent* or *Agents* to whom we are to aſcribe the Adminiſtration in this Syſtem? Is it in created Matter, or the Creator? Doth *Matter*, any Part of it, rule over and direct the Motion of the Remainder; or is the Hand, which gave Being to the World, continually, tho' unſeen, employed in performing the various Works of Nature, which are every Moment the Objects of our Admiration, as well as the Support of our *Being* and *well Being*?

On this Queſtion our Philoſophers are undetermined, ſeem however willing to lodge the Adminiſtration in the Creature; dubious

ſtill

ſtill upon the Point, becauſe ignorant of that mechanical Contrivance, by which one Part of the Creation is made to act upon, and give Motion to its ſelf and the reſt.

That God is not the immediate Agent, they would grant *moſt willingly*: And if they would not, the whole Face of Nature proves it. No ſecondary Cauſes need be employed, were they not able to perform the Taſk aſſigned them, and ſecondary Cauſes we ſee are employed. *But why may he not make uſe of them as his Inſtruments to work with?* Becauſe Omnipotence can work as well without ſuch Tools, as with. He need not, by an immediate Interpoſition, keep the Earth ſolid to ſupport Man, when he could with the ſame Eaſe ſupport his Feet, as keep together the Atoms for a Foundation for him to tread upon. He could move the Lungs without the Air, at the ſame Time that he makes the Air move them, and ſo have made but one Trouble of it. It is going round about, and doing *per plura*, what might as well be done *per pauciora*. To enable, and that by a continual Aid, a ſecond Cauſe to do what might be done without its Intervention, is needleſs, to ſay no worſe. It is not inconſiſtent indeed with the divine Power, to work in this Manner, becauſe Omnipotence is equal to the Burthen, but not conform to divine Wiſdom to ſet up an Agent, which can't work without an immediate Hand upon it, when that immediate Hand would perform the Taſk without calling in the ſupernumerary Officer. God could make us ſee without fetching Light from the Sun, to enable us to diſcern Objects by. It is no Trouble indeed to Omnipotence, to make the Air make the Fire burn, or Labour to him whoſe Power is unlimited, to carry the Earth in a Circle round the Sun, turning it at the ſame Time on its own Axis, in an Angle to its great Orbit, that all Parts may the more equally partake of the Light; but theſe, and ten thouſand Times ten thouſand other Actions, tho' Inſtances of the divine Power, (ſorry ones ſtill, in Compariſon of the ſingle Act of Creation) would be no Proofs of the Wiſdom and Foreſight of the Creator, but the very contrary, in making ſuch a Number of Wheels, ſuch a Variety of Works in his Machine, when not one of them could move without him, and the Work be done much eaſier, and more directly, without them.

But our Senſes aſſure us that many, nay we ſee that moſt, of the Operations of Nature are performed by ſecond Cauſes; we ſee not indeed the Mechaniſm by which they are performed; and what Authority have we to ſay thoſe Agents, thoſe Cauſes, do not the Work without an immediate Application of him who made them? Do they ſee the Hand of God upon them? No. That is not pretended to. Has he told them ſo? No. Why then is this aſſerted, *to prove the divine Power?* Either Way of acting proves that. *To prove the divine Wiſdom.* Where is the Wiſdom in making and employing Servants, which can't do the Work they are ſet about? A beautiful Contrivance or Concatenation of Cauſes would be a far more illuſtrious Proof of Knowledge, far more befitting the divine Goodneſs, than either to work by occult Qualities, or by an inviſible Hand; in both which Caſes Man would be deprived of the moſt convincing Evidence, ſenſible ocular Proof, of the Contrivance and Wiſdom of God; nay, would want Proof that theſe Things were dependent Creatures. But it is ſurprizing that they ſhould appeal to the Works of Nature for Proofs of Wiſdom in the Creator, who allow him leſs Skill, than to any common Mechanick. Man can make a Machine to go regularly, and methodically perform what he framed it for; but the Wheels of God's Machine can't go, unleſs his Finger be continually upon them. That Matter is capable of Mechaniſm needs no Proof, and the Creator could want neither Power nor Skill; and why then may not Things act mechanically? God has *affirmed* they do, and the Reaſon of the Thing ſpeaks the ſame Language.

If then the Creators do not act immediately by themſelves, we are to aſcribe the *Œconomy*

conomy to ſecondary Cauſes, leaving the great Originals no other Buſineſs in the *material* World, than to overlook, and occaſionally, when they ſee proper, over-rule the natural Agents.

The next Queſtion then is, which Part of the Creation hath the Power lodged in it—ſolid or fluid Matter? The Orbs or that Fluid in which they are placed? Or in other Words, is Motion performed by Impulſe, or a Power inherent in the Atoms of Matter, continually and neceſſarily exerting its Virtue, and ſo producing the Effects we are enquiring after? To ſay the latter, is to affirm without Knowledge; becauſe the Parts or Atoms of Matter are too ſmall to be the Object of our Senſes; nor are they any Ways capable of being brought under Obſervation, ſo as to give us an Opportunity of judging whether they have ſuch Qualities or not. Beſides, a Power acting inviſibly, or a Virtue which is immaterial, is not an Object of the Senſes, and conſequently not the Subject of our Knowledge. They ſay however ſuch Power is adherent to *Matter*; but he that created *Matter* hath not, that they pretend to, given them any Authority for ſuch an Aſſertion.

And with Submiſſion, it is unſaying what they lay down, with Regard to the Inactivity of Matter; for when they make Matter incapable of moving itſelf, it is ſo *a fortiori*, of moving any Thing elſe. If it be naturally paſſive, it hath no active Power in it. Nor are they at all helped out of the Difficulty, by allowing that ſuch Power is not originally in it; but ſuper-induced, or added to it by the Creator, a Law, as they term it, impreſſed on all Matter, for the leſſer Quantity to tend towards the greater; becauſe even ſo Matter would act without Means, and exert a Power, though it be allowed that ſuch Power was given it. If it cannot act of itſelf, it cannot receive a Power of acting of itſelf. If an Incapacity of acting be an Attribute or Quality naturally belonging to Matter, (which your very Conceſſion of Attraction, or any other of the Powers they talk of, being ſuper-induced, doth ſuppoſe,) ſuch Quality cannot be taken from it, and a contrary one given it. So their Solution of the Difficulty fails them. Omitting that they have no Authority for ſaying Matter hath any ſuch Power. Hath God told them ſo! No. Do they ſee ſuch Laws adhering to Matter! No. They ſee that Things move, and conclude that every Effect hath a Cauſe. They ſee that a Stone tends to the Earth; that the Earth encircles the Sun, and the Moon the Earth. All this is right enough, but this brings us not to the Point we aim at: Becauſe we do not ſee the Earth act upon the Stone, the Sun upon the Earth, or the Earth upon the Moon. To believe this or that Thing moves another, when we ſee it is not in the Place it is ſaid to act in, is to be more credulous than the moſt ſuperſtitious of the Papiſts. To affirm it acts by a Virtue inviſible, and confeſs we can neither ſee how, nor by Deductions reach the Manner of its ſuppoſed Operation, is to reſt on occult Qualities. To ſay the Weight or Force with which a Stone deſcends to the Earth, is owing to its Gravity, is ſaying no more nor leſs, than that the Weight of a Body is owing to its Weight. To offer to explain this, by ſaying the Earth attracts or draws it, is doubling the Cheat, becauſe the Horſe can't draw, unleſs he is faſtened to the Cart; and they have not, nor do they offer to ſhew us, the Chain which faſtens the Stone to the Earth, or Iron to the Load-ſtone.

Beſides in Fact there is no Law of this Nature in, or on, Matter. The heavieſt Bodies do not attract each other, as by ſuch a Rule they ought, with the greateſt Force. Nor is the Adheſion of ſuch Bodies the ſtrongeſt. Many Fluids are heavier than many Solids; their Adheſion it is plain infinitely leſs. The Load-ſtone attracts ſtrongly, Quickſilver not at all: A Diamond adheres ſtrongly, and yet hath leſs Matter in it, if we judge by Weight. If Attraction were a general Law, all Bodies ſhould attract each other, according to the Quantity of Matter in them. The Load-ſtone ought to have no more of this Virtue in it than a Diamond, or than Lead hath: Nor ought the Virtue in it to be more inclined to draw Iron, than to pull a Feather to it.

I do not ſay that our Philoſophers aſſert, that all Bodies attract alike, becauſe they can't help ſeeing the contrary; but if all Matter be alike, the ſame, as to the Form and Size of the conſtituent Atoms, and this Power be either connate to Matter, or ſuperadded to it, the heavieſt Bodies would attract the ſtronglieſt, which ſince they do not, I conclude that Attraction is not a Law of Nature, but performed by ſomething diſtinct from the, as they term it, attracting Body.

And if Gravity or Attraction, (and ſo we may ſay of all the other Nick-names they have blinded Philoſophy with) conſidered as a Quality inherent in, or ſuperadded to Matter, be in itſelf *irrational*, *unphiloſophical*, as well as *unproved*, and alſo contrary to the moſt common Obſervations, our Philoſophers are ſtript of their Agent, and we muſt look farther, than they have done, for the Cauſe of Motion.

If then the Creators neither act immediately by themſelves, nor have that we know of, nay, as far as we know, cannot give a Stock or a Stone, or one Atom, Power to move another, but by Impulſe; nor that impel, unleſs it be firſt impelled itſelf; we muſt look out to ſee what doth impel, and whence its Power ariſes.

This Power cannot be in the ſolid Orbs, becauſe they cannot act, or exert any active Power, where their Subſtance is preſent; much leſs can they act, where they are not preſent; or, which is the ſame thing, cannot impel without touching. So the Earth tends to the Sun, a Stone to the Earth, and Iron to a Load-ſtone, by ſome other Means. The Creator then doth not move Things himſelf, and Solids cannot.

It remains therefore that we aſcribe the Cauſe of Motion to the Air, or that fluid Sphere of Matter in which we breathe, in which Birds fly, and in which he, who made all Things, tells us, the Sun, Moon and Stars are placed.

A Plenum *aſſerted.*

This Subſtance is preſent in all Places which other Matter doth not fill. Its Atoms are contiguous and continuous from one Extremity of the whole Syſtem to the other, on which Side ſoever you make your Beginning. Diffuſed *quaquaverſum. Jovis omnia Plena.* It is the *Place* and *Placer* of all other Subſtances; material ones, I would be underſtood to mean; and is the *Agent* by which the OEconomy of Nature is carried on.

It may ſeem ſomewhat ſtrange that ſo extenſive a Power ſhould be lodged in a Subſtance, the greateſt Part of which is not *directly* the Object of our Senſes. And true it is, that its Exiſtence, as to far the greateſt Part of it, hath been denied; and before we give it Authority, it may be expected we ſhould prove it hath a Being. I ſhall wave that for the preſent, attempt to explain my Sentiments in Philoſophy, ſhew in what Manner I ſuppoſe the Actions are performed, and by what *Agents*, and occaſionally conſider the Arguments uſually offered in Proof of their Non-entity. In order to which I ſhall lay down ſome Poſitions, and afterwards appeal to Experiments and Obſervations, or have Recourſe to what other Methods ſhall appear moſt likely to evince the Truth of thoſe Poſitions: And if I am right in theſe Poſitions, it will be but little Trouble to prove from thence the Sufficiency of the ancient, and the Inſufficiency of the modern Philoſophy.

First then,

Poſ. 1. Matter was created in Atoms, or ſmall Parts, which are not capable of being divided, made leſs, or any Ways altered.

Secondly,

Poſ. 2. There are many Sorts or Species of theſe Atoms, which differ from other in Size and Shape.

Solids conſiſt of Atoms of one Sort, Fluids of another. Different Solids may conſiſt of Atoms of the ſame Figure, but differing in Size; or, of the ſame Size, but varied in Figure. And ſo for Fluids and the various Kinds of Fluids. And Solids and Fluids may differ both in one and the other, and approach nearer in the Sort of Atoms which compoſe them, as they approach nearer each other in Condition.

Thirdly,

The Air conſiſts of Atoms of the ſmalleſt Order; theſe are capable of adhering to each other, and forming Maſſes or Grains, as well as thoſe of many other Bodies, as Gold, Lead, *&c.* *Poſ.* 3.

Fourthly,

The Air is a Mixture of Atoms and Grains, *i. e.* ſome Part of it is looſe, and ſome formed into Grains, as if Wheat and Flower were to be mixed in a Veſſel. In ſome Places there is a greater Quantity of the one, and in others, of the other. Round the Orb of the Sun the Atoms exceed vaſtly in Number; and at the Circumference, or near the Limits of the Univerſe, the Condition of the Air is different, and is moſtly formed into Grains. *Poſ.* 4.

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Defin. of Light and Darkneſs, and Spirit. The one Condition of the Air we call *Light*, the other Darkneſs. Which two are the ſame Subſtance, or conſiſt of Atoms both of them, of the ſame Species, of the ſame Figure and Size, and differ only in Condition, as one is ſtorken'd, cold, or adhering in Grains; the other *(Light)* looſe, detached, the Atoms from each other, or melted. The Parts of Darkneſs when in Motion we call *Spirit*, becauſe all Nations have called it ſo, or by a Word of the like Import.

Fifthly,

Poſ. 5. The Grains continually deſcend to the Sun, preſs out the ſingle Atoms and take their Place; are there broke to Pieces or divided, and then themſelves preſt out by ſucceeding Grains, which are likewiſe by Colliſion in the Pores of the Orb of the Sun, and by the Atoms which ſurround it, (and which the Grains run againſt as againſt Spikes) broke to Pieces, or ground to Powder, as the preceding ones were. The Grains when ſo reduced, or divided into Atoms, when preſt out, fly off to the Circumference, adhere again or form into Maſſes, (as other melted Bodies do, when removed from the Fire) and ſo return back to the Sun, by which the Action is continually ſupported, and the Sun continually ſupplied with Matter to ſend out in Light, and ſo the whole of this Fluid from Center to the Circumference of the Syſtem, from the Sun, to beyond the fixt Stars, is continually in Motion, Part going to the Sun in Form of Darkneſs, and Part coming out in Form of Light; the one in Streams preſſing to the Sun, the other in Streams flowing in all Directions from it, and this without Ceſſation, perpetually changing Place and Condition.

Matter was created in Atoms, or ſmall Parts: This every one, who knows and believes that Matter was created at all, doth acknowledge. Nay they, who denied that the World was created, held that it conſiſted of minute Parts or ſmall Bodies, which are of ſome determinate Size and Shape; and it is impoſſible to think otherwiſe, becauſe it is impoſſible to conceive a Notion of any Body which hath not ſome Size, and ſome Sort of Shape: And if they had them (their Size and Shape) by Creation, it will be impoſſible by any Art, Power, or Strength of Man, or of any Thing, or any Agent, but him who gave them their Form, to alter it. What ſhould alter or make the Atoms different from what they were created? And that the original Atoms are unalterable, appears pretty plainly, becauſe all the Tricks we can play with Things, or all the Attempts we can make upon them, never alter them, or change their Nature: As for Inſtance, Water can never become Gold; which is a ſufficient

Proof of my firſt Poſition. Indeed, it hardly wants any.

That different Bodies do conſiſt of Atoms which differ from each other, is as plain, as that they conſiſt of Atoms at all. What elſe ſhould make that inſuperable Difference betwixt Water and Gold, but a Difference betwixt their conſtituent Parts. It is impoſſible to change Water into any other Subſtance; by the Addition of other Matter, its Appearance may be changed, which proves for us, becauſe it will not change without ſuch Addition: Take away that adventitious Matter, and its Appearance is then the ſame it was at firſt. What Reaſon elſe can be given why one Body is ſolid, and another fluid? Suppoſe the component Particles, all of them of the ſame Kind, and place them in whatever Situation you pleaſe, to each other, that could make no material Alteration.

The original component Particles muſt therefore vary in ſome Reſpects; and in what other can they, but in Size and Figure? And he, who could make one Atom of one Figure, could make another of another, and ſo for Size: And ſome Size and ſome Figure they muſt have.

Their comparative Figure and Size we are to gather, and in ſome Meaſure may gather it, from Obſervation. Thus thoſe of the Fluid of the Air, we judge to be the ſmalleſt Atoms,

toms, as well becauſe without that they would not anſwer the End they were made for, as from Obſervation, by which we find they pervade all other Bodies, a Diamond, for Inſtance, Glaſs, nay, the Earth itſelf, to the greateſt Depths, as Dr. *Woodward* hath * proved. That the Sea is pervaded by the Air to the very Bottom, is well known, Fiſhes breathing and ſwimming there is a Proof, becauſe they can neither ſwim nor breathe in *Vacuo*, or where the groſs Air doth not come; which (all together) prove that the Atoms of the Air are ſmaller than thoſe of which other Bodies are compounded, ſince they can paſs between the Interſtices or Pores, which are in other Bodies. As to the other Part of our third Propoſition, the Adheſion of theſe Atoms in Maſſes or Grains, as Lead, Sand, &c. do, many Experiments, and the moſt common Obſervations may be appealed to in Proof of it. Hold your Hand before a Fire, you feel Heat before, and Cold behind: You perceive Air preſs in, out again it muſt come, annihilated certainly it is not. It comes not out however in the ſame Condition it went in. It goes in cold, and comes out hot. Heat, we know, pervades and enters the Pores of the Hand, which Cold cannot. This leaves no Doubt that the Air is divided or diſſolved in the Fire, as Metals are, and forced out by ſucceeding Air or *Spirit*; ſo that the Atoms of

* *Natural Hiſtory of the Earth illuſtrated*, &c. The 3d Letter in the *Preface*.

the Air are capable of adhering in Grains, of being divided and adhering again afterwards. Some Parts of the Air, as was obſerved, eaſily pervade the denſeſt Body we know of; and other Parts of it, again, don't make their Way through the lighteſt. Glaſs admits ſome of it in Form of Light and Heat, but ſtops that, or moſt of that, which is in Form of Cold or Wind. A Candle burns no longer than the denſer Part of the fluid Mixture of the Air can come at it, to feed it, they ſay. But what is feeding it? Is not Food, digeſted, diſſolved, or divided into ſmaller Parts in the Stomach? And ſo muſt the Food of a Candle, if they will call it ſo; and when it is ſo divided, it is carried off in the other Condition of Light and Heat. This again proves that Spirit and Light are the ſame Subſtance, whoſe Atoms in Size and Shape are the very ſame, becauſe Diviſion and Adheſion make them one and the ſame: But Gold, Water, Lead, and ſo forth, whether adhering in Grains, or divided into Atoms, neither are, nor appear to be, nor perform, what Air, by this alternate Change of Condition is, appears to be and performs. Gold, and the other Bodies, indeed, are proved to be different from each other, becauſe Diviſion and Adheſion of their Parts never make them aſſume the Qualities of each other. And why may not Air be conceived capable of being melted and ſtorkning afterwards, of growing cold or hot, as it is agitated or quieſcent, as well as Gold, Lead, and ten thouſand other Species of Subſtances? What is there in the one, to impede, which is not in the other in ſome Proportion? A Fire or a Candle is a plain and obvious Proof of the Matter of Fact, and ſo are many of the Experiments made by the Air Pump. This Engine, which hath deceived the brighteſt of Men, when the few Points above are ſettled, will not only undeceive them, but prove this, and open the knottieſt Parts of Philoſophy to the moſt ignorant and ſhort-ſighted. It is well known that Light may be formed in the condenſed Receiver by rubbing two hard Bodies together. What doth this do, but grind the larger Grains, which were too big to paſs the Pores of the Glaſs, or to pervade thoſe of the Eye, which a ſingle Atom, or ſome few in a ſmall Grain can do? Exhauſt the Receiver of the denſer Air or Grains, and rub the Outſides of it with your Hand, immediately Light flaſhes out. What doth the Hand do but move the Atoms next it, and they the next to them, and ſo on, till thoſe next the Eye are puſhed into it, as if you were to puſh a Stick which touches the Eye at the oppoſite End. Were the Line of Atoms interrupted in any Part, the Motion of the Hand on the Sides of the Receiver would neither reach nor affect the Eye, any

See Hawſbee's *Experiments.*

more than a Stick that did not touch it. Here then we ſee that the Atoms, (which when puſhed into the Eye, we call Light) are continuous in a Line from the Hand, through the Receiver to the Eye, and that they are ſmall enough, (when puſhed) to run through the Glaſs, as Water through a Sieve, and conſequently when you force the *Spirit* into the Receiver, the thinner Parts of the Air or the Light gets out through the Glaſs, which hath made the Learned think the exhauſted Receiver had little or nothing in it, and that Light was no Part of the Air; whereas our ſeeing through it, ſhews it is full of Light, for every Fool knows we can't ſee without Light. Light therefore muſt be in every Part of it, becauſe we can ſee in every Part of it. Hence we gather that what is called a Vacuum, ſaid to be empty Space, is really a Plenitude of Matter; but this by the by; what I brought theſe Experiments for was to prove, and they give us ample Proofs, both that the *Spirit* may be grinded into Light or Heat, or what our Philoſophers have puzzled themſelves about, and called a *ſubtile Fluid*; and that *Light* and *Spirit* are mixed together, and capable of changing Conditions, or in other Words of being divided or adhering again, and ſo will be more or leſs fluid and penetrating, as it adheres in greater or ſmaller Maſſes. You will aſk perhaps how they adhere

A Plenum *proved.*

adhere and form into Maſſes! How do the Parts of Lead adhere after they are melted? In the ſame Manner, and by the ſame Means that one adheres, the other may. It is the Matter of Fact I am now contending for, in order to ſhew what is that inviſible Agent which they have called a ſubtile Fluid, and made ſo much jeſt of, and yet have themſelves confeſſed its Exiſtence in all Parts of Space, and in the Pores of all Bodies, though what it was there for, they have given us no Account. It is we ſee the Atoms of Air, which are ſmaller than thoſe of any other Body, ſo can make their Way through between the Pores in all other Bodies, when looſe or ſingle; but when adhering in Grains overlap the Pores, and ſo preſs upon the Surface of any other Body without entering it.

Were the Fire at the Sun to ceaſe, the whole of this Fluid would be one entire ſolid Lump, would ſtagnate entirely, ſo it did in *Ægypt* to a very great Degree, and ſo we are told it doth at the Circumference of the Syſtem, and ſo it doth here in different Degrees, in Proportion as the Irradiation increaſes or decreaſes. Witneſs the different States of the Air in Winter and Summer, near the Poles, and under the Line. All this is owing I ſhall be told to the Atmoſphere having in it a greater Quantity of Light and Heat from the Sun in Summer than in Winter,

ter, under the Line than near the Poles. But what is Light, how is it formed, and of what Subſtance? I have appealed, and do appeal again to a culinary Fire, that *Light* and *Spirit* are the ſame Subſtance, differing only as Metals melted and unmelted, or as Wheat in Grains and Flower doth. And if ſimilar Cauſes produce ſimilar Effects, or invert the Axiom, if ſimilar Effects are owing to ſimilar Cauſes, the ſolar Fire and a culinary one muſt be ſupported in one and the ſame Manner, and produce the like Effects; from whence my Conſequence is eaſily deduced, that *Light* is melted *Spirit*, and that Light condenſed, ſtorkned or cold, becomes *Spirit* again: Which give me another Step or two, that the *Spirit* and *Light* are intermixt, and do reach from hence to the Sun, and that in all Directions, becauſe the one cannot act without the other. Take away the *Spirit*, and the moſt violent Effects of Fire, as well as the more gentle ones of Light and Heat ceaſe with it. Neither a Fire or Candle burn any longer than the *Spirit* comes at them. Which prove my *third* and *fourth* Propoſition, and partly the fifth.

That the *Grains* or *Spirit* continually endeavour to preſs into the *Light*, and take Place of the Atoms, appears from many Obſervations. Witneſs the Draught to a common Fire. Witneſs the Wind which preſſes into the Touch-hole of a Gun when fired, and which attends the Ball till its Force is waſted. Witneſs the Exploſion of a Rock by Gunpowder confined in it. Witneſs the exhauſted Receiver. But why need I multiply Inſtances to prove what they cannot deny me, that the groſſer Air preſſes upon, and endeavours to take Place of the thinner. And it is proved, I think, that Light, or the thinner Air is their ſubtile Fluid; which the groſſer Air or *Spirit* preſſes out from the Fire, and into the Place of which it ruſhes when the ſudden Fire in Gunpowder hath performed the Part of Fire in common Fuel, and ſo reduced a Portion of Air into Light. For Fire acting in Fuel is before proved to diſſolve the Air. The Gunpowder is the Fuel here, diſſolves when ſet a burning; the Air in the Touch-hole, on which the unmelted Air next without, drives in, forces the melted Air before it, and carries the Ball along with it. So in a Rock. So in the exhauſted Receiver, which you may eaſily perceive by the Preſſure on your Hand, when you lay it upon the Mouth. The Wind Gun is another plain Proof, that the denſer Part of this fluid Mixture is always endeavouring to expand itſelf, and take Place of the thinner.

With what Force and Violence, or how great the Force and Strength of this Expanſion is, may in ſome Meaſure be collected

by

by conſidering the Effects of a Storm or Hurricane, its ſurprizing Violence and Rapidity. The incredible Effects of Lightning and Gunpowder,. (when cloſe confined, ſo that the *Spirit* drives in only in one Line, and is not oppoſed by an oppoſite Puſh) in a Rock or under Ground, will lead us to the ſame Concluſion, *viz.* that the expanſive Power of the Air, (or Force with which the *Spirit* endeavours to take Place of the *Light*, or the thinner Air) is beyond Expreſſion great, where any conſiderable Quantity of it is of a ſudden put into the oppoſite Condition.

The Atoms of Light enter, for Inſtance, a Diamond, tear its Parts aſunder, divide them, or diſſolve it, when collected by a Burning-Glaſs. What is there to do this! The Subſtance of the Light enters the Pores of the Diamond, and force aſunder the Parts which compoſe it. But what drives the Light in; of itſelf it cannot move, ſomething muſt impel it; and Thought can ſcarce conceive the Strength neceſſary to rent aſunder what adheres ſo ſtrongly. What doth the Glaſs do, but admit the Atoms of Light, and ſo ſeparate them from the Grains or *Spirit* which cannot get through it? But then the Stream of Light could not enter unleſs drove behind, nor with that Violence, unleſs impelled by ſome powerful Agent: And what is there to do this but the *Spirit*, and that it can impel the Parts of Light, we have already ſhewn. This Agent brought it from the Sun hither, and why may it not be allowed Force enough to drive the *Wedge* of Light into the Diamond, and cleave it to Pieces? This muſt do it, becauſe we know the moſt violent Effects of Fire ceaſe inſtantly, when its Action is taken off, or abated, when its Action is abated: And this gives us ſome Idea of the Strength of the Expanſion, in which the *Spirit* is the Inſtrument of Motion.

And that which moves ſome Bodies, and hath ſuch prodigious Power, may any. That which will rent Rocks, and tear a Diamond to Pieces; that which will drive the ſolideſt Buildings before it, nay, deſtroy whole Countries at a Blaſt, may do many other Things we little dream of its doing. It is not for want of Power, it is plain. Who can command the Fire, or check its Fury? Who can ſtop the Progreſs of Light, or ſet Limits to the *Spirit*, and ſay to it, as that doth to the Sea, " Hitherto ſhall thou come, " but no farther, and here ſhall thy proud " Waves be ſtaid."

And theſe Agents are one and the ſame Subſtance, conſiſt of the ſame Unites, are reciprocally changeable into each other, and their Power ariſes from their joint Action, and ſubſiſts by their continual changing Place and Condition, from the Preſſure of one into to the Place of the other, ſo ariſes from the Struggle, as it is emphatically expreſſed, between them.

We can make Obſervations and Experiments but upon ſmall Quantities of each, and with great Diſadvantages; but theſe are ſufficient to prove their Power, and the Means it riſes from, and by which they exert it. Do but conſider the Condition the Air is in, and the Condition of the Thing it acts upon, and it will appear that theſe are the ſecondary Cauſes, which God hath appointed his Vice-Roys, and that all the Phænomena of Nature are the Effects of their Agency. But act they cannot, where they are not preſent, therefore they are preſent, wherever any Actions are performed. But,

Objections againſt a Plenum *anſwered.*

Motion, ſay our Philoſophers, *is inconſiſtent with a Plenum, there can be no Motion, unleſs there be Room for a Body to move into.* True; a Body can't go into an empty Place, unleſs there be an empty Place for it to go into; nor change Place with another, unleſs that other quit its Ground; but if that other do quit its Ground, a Body may move by changing Place with it. Suppoſe a Bullet in a Bottle of Water, cloſe ſtopt: The Bullet moves when you ſhake the Bottle; not by going into empty Space, for there is none for it to go into; not by condenſing the Water, and ſo making Room for itſelf to move in, for all the Force the Power and

Art of Man can uſe, can never compreſs Water into a leſs Space than it naturally fills, much leſs the ſmall Preſſure which ariſes from ſhaking the Bottle, and thereby driving the Bullet againſt the Water which encompaſſes it. And how doth the Bullet move in this Caſe? Doubtleſs by puſhing the Water before it, which inſtantaneouſly comes into the Place behind, which by Motion it retires from. What Occaſion for empty Space here; the Bullet takes up no more Room in one Part of the Bottle than another; all together juſt fills the Bottle, ſo they have juſt as much Room as they want, and no more.

If the Bullet be ſuppoſed an Inch in Diameter, an Inch of Water muſt go out of its Place, before the Bullet can move into another Part of the Bottle. " And where doth " that Inch of Water go to?" why it drives another Inch before it. " And where doth " that other go?" into the Place the Bullet vacated. Suppoſe A, B, C, and call the Bullet D, D then moves by driving A into the Place of B, and B by driving C into the Place of D; and there is plainly, and beyond Diſpute, no Pore or Vacancy in the Bottle big enough to receive either A, B, C, or D. " *But how can* D *poſſibly move, muſt it not* " *move* A *out of its Place before it can come* " *into it? muſt not one move before the* " *other?*" I have heard the Learned argue ſo, and ſeem to make a Doubt of the Poſſibility of a Ball of Lead moving in a Bottle of Water ſtopt cloſe for want of Room, ſo I ſhall not take upon me to ſay which moves firſt, or offer to ſolve what appears to be ſo great a Difficulty, but the Fact is palpably plain. That there is no empty Space in the Bottle big enough for the Bullet to go into; and there is no Power in the Water of playing the Merry-Andrew, as your ingenious Men have dreamt of the Air's doing, contract and dilate itſelf at Pleaſure, is certain; ſo this is to the Objection before us a Plenum to all Intents and Purpoſes; and, I think, that the Water and Bullet move both at the ſame Time. I cannot conceive the Bullet to move forward, but the Water behind ſucceeds into the Place it left, as the Water before gives Way; all at the very ſame Inſtant; all move together; and the Bullet takes up no more Space in one Part of the Bottle (as I ſaid) than another, and ſo wants no Part of the Bottle empty for it to go into. It only wants the circumambient Matter of ſuch a Condition, as to be capable of giving Way, or ſhifting Place; and you may as eaſily conceive a Grain of Air changing Place with the circumambient Atoms, as a Bullet changing Place with the circumambient Water. So the Earth, *e. g.* incloſed in a Sphere of fluid Matter, whoſe Subſtance is extended through all Space that we know any Thing of, and whoſe Atoms are contiguous and continuous in all Directions; the Earth, I ſay, though incloſed in this Plenitude of Matter, moves forward by the Fluid before giving Way, and that behind coming into its Place.

"*But the Air is a Fluid, and therefore, by its Tenacity, muſt impede a Body's moving in it, reſiſt and retard its Progreſs.*" Not, if the Air before, moves as faſt as the Body which purſues it. "*But the Body may move faſter.*" It may ſo, and then its Motion will be retarded. "*How muſt it get forward then?*" By the Impulſe behind being greater than the Reſiſtance before. In a calm Water, the Tide or Current will carry a Veſſel. Doth the Water before reſiſt its Progreſs? Suppoſe ſo. Doth not the Preſſure behind over-balance both the Weight of the Veſſel, and Oppoſition of the preceding Water? It is the ſame Thing, whether you ſuppoſe the Veſſel above or under the Water; the Current behind ſtill drives it on, and overcomes the Reſiſtance which ariſes from the Weight of the Veſſel, and from the Water which the Veſſel overtakes in going on. And ſo the Earth moves, or which is a leſs complicated Caſe, ſo a Stone moves, when a Current of Air is made by the Hand that projects or caſts it forwards; and neither the Reſiſtance before, nor Fullneſs, *i. e.* Want of empty Space, are any Objection againſt Motion in a Plenum.

Theſe Gentlemen, though curious enough in moſt Reſpects, and very nice in their Diſtinctions, miſtake the Caſe here, and inconſiderately (with due Reſpect let me ſay it) inconſiderately argue, that Motion and a Plenum are inconſiſtent, becauſe Solids can't move among Solids; and that all Matter would be as one ſolid, were its Atoms contiguous in all the Points the Smallneſs of the Atoms would admit of. But this proceeds upon a Miſtake that all Matter is the ſame, or that its component Parts are originally alike. We have all the Reaſon in the World to conclude the contrary, and therefore our Caſe is Solids moving among Fluids, (or larger Atoms moving among ſmaller,) which ſhift and give Way, not by going into empty Space, but changing Place with the moving Body, as the Water doth with the Bullet, which takes up no more Space in one Place than another.

This rightly conſidered, the Objection wholly vaniſhes, and what they urge in Diſproof of a Plenum, is really and in Truth an invincible Argument for it. For nothing can move without a Mover, and no *material* Mover can act otherwiſe than by Impulſe, nor impel, unleſs it be in Contact with the Thing it puts into Motion. And when the Motion is from one End of the Syſtem to the other, as in the Caſe of Light, there muſt be Contact all the Way, and in every

Direction. So the Subſtance muſt be extended (the Atoms continuous) throughout the Syſtem; which ſhews what I am contending for, that no Space as far as Motion reaches, (and where doth not Light reach to) is empty or void of Matter.

There can be no Space which is big enough to hold an Atom, without one in it; becauſe ſuch Defect would break the Line, a Link would be wanting in the Chain, and the Motion muſt ſtop when it came to the Gap. When you move one Marble in a Ring, the whole Ring moves. Take one out, and the Motion will be continued no farther than the Marbles are in Contact. So would it be with the Atoms of Light in their Irradiation from the Sun, were not each touched by another, both before and behind, throughout the whole Diſtance. So what they call empty is as full of Matter as a Diamond. Nay, fuller, (were you to add together the ſolid Contents of the Atoms which compoſe each) becauſe thoſe of the Light are ſmaller, and ſo lay cloſer than thoſe of a Diamond, and conſequently there will be a greater Number in an Inch of the one, than in an Inch of the other. As the Atoms of Light are ſmaller than thoſe of a Diamond, the Vacancies between them muſt be leſs than thoſe between the other, and ſo the Quantity of Matter will be greater in an Inch of Air or Light, than in an Inch of Diamond or Gold, or in any other Body, whoſe conſtituent Parts are larger, becauſe there muſt be leſs empty Space in it. And the different Appearances, Effects and Qualities of Air, Gold, Diamond, Water, &c. depend originally upon the Size and Shape of the Atoms which compoſe each, not on the Quantity of Matter in them.

Their other favourite Argument for a Vacuum, that on the contrary Suppoſition all Bodies muſt weigh in Proportion to their Surface, not according to the ſolid Contents, is founded on two Errors, both of which we have already exploded, namely, that Gravity is an Affection of Matter as ſuch, or that a ſingle Atom would gravitate or be attracted by any large Body it lay near, the Earth, Sun, or &c. though nothing touched it on any Side. And that all Matter is the ſame, or conſiſting of Atoms of the ſame Size and Figure, which are two groſs Miſtakes. The Particles of Matter muſt by Creation have ſome Size and ſome Shape; and he who could make one Atom round, could make another Square, and ſo on. And what can alter, or why ſhould we ſuppoſe any Thing capable of altering the *Form* which by Creation it received, excepting the Creator alone? If then the Corpuſcles of Matter are ſome bigger and ſome leſs, ſome of one Figure and ſome of another, and that by Creation, and conſequently immutably ſo; the

Quantity of Matter in a Body, by which they would judge of the Weight, muſt itſelf be judged of by other Rules than they have laid down; and the Weight, Tenacity, or Adheſion, Attraction and Elaſticity, will depend alike on the Form and Magnitude of the component Parts of Bodies, the larger and ſmaller, round and ſquare Atoms will reſiſt differently any Thing which preſſes upon them.

If the Fluid of the Air fill all Bodies as Water doth a Spunge, and do communicate with ſome Part of the Fluid without, its Preſſure will be continued on that which is within the Body, and ſo to every Atom of the Body. If they can prove that a larger Atom doth not weigh more than a ſmaller one, (an Atom of Diamond than an Atom of Water, *e. g.*) or that the Weight of two Atoms is not in Proportion to their Surfaces, I will grant their Argument. But it is no Objection to my Scheme that the Weight of a Body is according to the Quantity of Matter in it, ſince every Atom in the Body is preſſed upon: And Atoms of different Size and Shape, without all Doubt, are differently affected. Enlarge the Surface of a Body, and a great Part of the Air above it will run through, and take no hold of it: Or if more from above preſs upon it, more from beneath in the ſame Quantity will reſiſt its Deſcent. Reduce a Body into ever ſo ſmall mond or Gold, or in any other Body, whoſe conſtituent Parts are larger, becauſe there muſt be leſs empty Space in it. And the different Appearances, Effects and Qualities of Air, Gold, Diamond, Water, *&c.* depend originally upon the Size and Shape of the Atoms which compoſe each, not on the Quantity of Matter in them.

Their other favourite Argument for a Vacuum, that on the contrary Suppoſition all Bodies muſt weigh in Proportion to their Surface, not according to the ſolid Contents, is founded on two Errors, both of which we have already exploded, namely, that Gravity is an Affection of Matter as ſuch, or that a ſingle Atom would gravitate or be attracted by any large Body it lay near, the Earth, Sun, or *&c.* though nothing touched it on any Side. And that all Matter is the ſame, or conſiſting of Atoms of the ſame Size and Figure, which are two groſs Miſtakes. The Particles of Matter muſt by Creation have ſome Size and ſome Shape; and he who could make one Atom round, could make another Square, and ſo on. And what can alter, or why ſhould we ſuppoſe any Thing capable of altering the *Form* which by Creation it received, excepting the Creator alone? If then the Corpuſcles of Matter are ſome bigger and ſome leſs, ſome of one Figure and ſome of another, and that by Creation, and conſequently immutably ſo; the

Quantity of Matter in a Body, by which they would judge of the Weight, muſt itſelf be judged of by other Rules than they have laid down; and the Weight, Tenacity, or Adheſion, Attraction and Elaſticity, will depend alike on the Form and Magnitude of the component Parts of Bodies, the larger and ſmaller, round and ſquare Atoms will reſiſt differently any Thing which preſſes upon them.

If the Fluid of the Air fill all Bodies as Water doth a Spunge, and do communicate with ſome Part of the Fluid without, its Preſſure will be continued on that which is within the Body, and ſo to every Atom of the Body. If they can prove that a larger Atom doth not weigh more than a ſmaller one, (an Atom of Diamond than an Atom of Water, *e. g.*) or that the Weight of two Atoms is not in Proportion to their Surfaces, I will grant their Argument. But it is no Objection to my Scheme that the Weight of a Body is according to the Quantity of Matter in it, ſince every Atom in the Body is preſſed upon: And Atoms of different Size and Shape, without all Doubt, are differently affected. Enlarge the Surface of a Body, and a great Part of the Air above it will run through, and take no hold of it: Or if more from above preſs upon it, more from beneath in the ſame Quantity will reſiſt its Deſcent. Reduce a Body into ever ſo ſmall a Compaſs, ſtill the Fluid, whoſe conſtituent Parts are ſmaller, will enter its Interſtices, carry its Preſſure, ſo *Gravity* to every Atom, in the largeſt Body you can ſuppoſe. Were the Fluid, to whoſe Preſſure we aſcribe the Cauſe of Gravity, ſo groſs as not to be capable of pervading the Pores of a Body, the Preſſure would be in Proportion to the Surface: But ſince Part of the Air can and doth find its Way into the Pores of all Bodies, the Weight of a Body will be *cæt. par.* (and making Allowances for other Circumſtances, ſuch as the Shape and Size of the Atoms) according to the Number of Atoms or Quantity of Matter in a Body. And however cloſe compacted it is, every Atom will partake of the Preſſure; and whether they lay near or farther aſunder, the Weight will be the ſame, or at leaſt the Difference will be next to nothing. When the Surface is enlarged, the groſs Air which overlaps a Pore and covers two or more Atoms at once, will buoy it up: Take that away as in the exhauſted Receiver, and it will fall as quick as a heavier Body. But the ſame Body ought not to vary in its Weight, at leaſt very little, as its Surface varies, becauſe every Atom of it is always expoſed to the Preſſure of the Air, whoſe *action* may reach, becauſe its Subſtance doth to the Center of any Body whatever, ſuppoſe it as large as you will; the larger Surface will intercept more of the *Spirit*, but not more of the *Light*; which removes the only remaining Difficulty that attends, or is thought to attend, the Side of the Queſtion I am defending.

If then there be no Space void of Matter, as all their Philoſophy is built on a Suppoſition that moſt of it is ſo, it falls at once. Not one of their Laws are conſiſtent with it. And this muſt be allowed, till they can ſhew us, that Matter can act where it is not preſent, or that God performs immediately by himſelf what we call the Operations of Nature. They muſt allow us a Plenum, till they can ſhew that the Effects of Fire, ſuch as Light and Heat, do or can ſubſiſt without an Intermixture of groſſer Air or *Spirit* coextended with them; or that one Atom can come out from the Fire unleſs driven out by another coming in, or go farther than the Impulſe and Contact of another is upon it.

To ſay it muſt move when ſet a-going, till it is ſtopt, and that for this Reaſon, becauſe it is incapable of acting is really making it *act*, becauſe by Suppoſition it hath no Power of *acting*. Is not keeping in Motion *acting*? "*But when put in Motion it can't* "*ſtop itſelf*." This is fallaciouſly expreſſed, undeſigned I am ready to allow, becauſe theſe Gentlemen have ſhewn too much Candour and Ingenuity in all their Writings, to be thought willingly to impoſe upon others. However, this is a Fallacy, and a very groſs one; to argue that a Stone, for Inſtance, moves on, when delivered out of the Hand, becauſe it can't *ſtopt* itſelf, ſince there is no Occaſion for it to *ſtop* itſelf, unleſs it could firſt be ſuppoſed capable of *moving* itſelf, or of moving longer than it is moved. It can only move, when moved, and why ſhould it move longer? Let the Power which moved it ceaſe acting or withdraw itſelf from the Contact, and if nothing elſe intervene, the Motion of the Body muſt ceaſe likewiſe becauſe the Cauſe hath. The Stone neither moves itſelf, nor ſtops itſelf; and when out of Contact, if you could ſuppoſe it ſo, with any other Subſtance whatever, muſt abſolutely lay ſtill. The Hand, I preſume, cannot act where it is not preſent, how then doth it move the Stone when at ſome Yards diſtant from it? "*Why the Hand communi-*" *cates a Force which is ſoon waſted, and* "*then the Stone drops.*" But how do they know that? Do they ſee any Virtue in the Hand to go out of it; or do they ſee a Virtue go out of it? No, they ſee neither. How do they know then there is any ſuch Virtue or Power in the Hand? "*Why the* "*Stone moves, and that the faſter and the* "*farther in Proportion to the Strength the* "*Hand jirks it with?*" True it doth ſo. But is there no other Subſtance in Contact with it, to take it when delivered from the Hand? "*They ſee none.*" Nor do they ſee the Force come from the Hand, or any Virtue iſſue out of it, any more than they ſee the Power which occaſions the mutual approaching of Iron and the Load-Stone. They ſee the Effect in both Caſes, but not the Agent; and if Matter can act only by Impulſe and in Contact, there muſt be ſome Species of Matter which takes the Stone when delivered from the Hand, or elſe it could not move an Hair's Breadth farther than the Hand carried it. Children do not ſee the String or Wire which Punch is danced by; nor do wiſer People; but they conclude that there is ſome Wire, though they don't ſee it. Neither Children nor Men ſee the Air (the Wire) betwixt us and the Sun, and by which it or any Object we look at acts upon us, but it is to be as ſilly as Children to imagine there is none. Had they reaſoned cloſely here, and adhered to their own Principle "of not believing what they did not "ſee," they would never have talked of a Virtue coming out of the Hand or a Load-Stone, becauſe they ſee none come out. The Hand hath no more Share in the Motion of a Stone, than the Oar or Sails have in the Motion of a Ship or Boat.

Suppoſe our Eyes had been fitted to ſee a Boat but not the Water which carries it; then the Rower would have ſeemed to have played his Oar *in vacuo*, as it would have been called. Would it have been philoſophical to have ſaid, that flouriſhing the Oar about communicated a Virtue or Power of moving to the Boat; and that the Boat muſt continue to move, becauſe it could not ſtop itſelf? It would have been modeſt to have ſaid, they did not ſee what moved it, inſtead of talking of Virtue iſſuing out of a Bit of Wood, or a Bit of Cloth to make it do ſo. They ſee a Ship move when its Sails are ſpread, but ſee not the Wind which acts upon them, and by them on the Ship; yet they acknowledge the Action of the *Spirit* here. But the Sails might as well move the Ship, as the Hand a Stone, did not a Current of Wind ſet in after them? The Sails indeed intercept the Current made by ſomething elſe; and the Hand with the Stone makes one in the Line you direct it. Why ſhould it be thought ſtrange that your Hand ſhould make a Current in the Air, when it is ſo eaſy to make one with your Hand or a Stick in the Water, which hath the ſame Effect though in a leſſer Degree? People ſhould learn to look for the *Cauſe*, and not imagine they play the Philoſopher when they name the *Effect*, and give that Word as the Cauſe: Projection, Gravity, and ſo forth, may be proper Words to expreſs the *Effects* by, but to ſay a Stone moves by Projection, Gravity, or Attraction, ſpeaking philoſophically, is arrant Nonſenſe, and an Impoſition on our Underſtandings.

Let us now recapitulate.

The Operations of Nature require ſome Cauſe.—God is not the immediate Agent, becauſe it is inconſiſtent with his Wiſdom and Goodneſs, as well as his own expreſs Declaration.

Occult Qualities exiſt and operate only in the Imagination of Fools and Madmen.

The ſolid Parts of the Creation, *viz.* the Orbs, Sun, Earth, Moon, *&c.* cannot act at all, much leſs where they are not preſent; and the Operations are performed at a Diſtance from them. They *naturally* are incapable of acting, ſo it is *unnatural*, as well as without Evidence to ſuppoſe any active Power hath been, or can be, communicated o them.

Some Mechaniſm then there muſt be, in Order to this, the Subſtance of the mechaniſed Matter muſt be as extenſive as its Power. If he whole be not in Contact, the Motion of one Part could not affect another: From whence we learn, that nothing can move by Gravity, Attraction, Projection, Elaſticity, or Powers exerted at a Diſtance. That there muſt be a Plenum, or that the Atoms of Matter touch each other from the Center to he Circumference of the Syſtem: And that he Species of Matter which conſtitutes the Plenum, and hath the Power in it, is fluid, without which it could not ſhift Place with Solids, or let them move in it.

And that Motion in a Plenum is poſſible, we have an eaſy and indiſputable Proof, from an Experiment which requires no grand Apparatus of Inſtruments to perform it with, or any great Abilities to underſtand and deſcribe. A Bullet or a Pebble-ſtone, and a Bottle of Water, are eaſily to be had. The Bullet will move in the Water, let the Bottle be ſtopt ever ſo cloſe: It finds Room to move in, not by puſhing the Water, or going itſelf into empty Space, for there is none for it to go into; but by changing Place with the Water, or making t circulate round into its own.

That the Fluid of the Air hath no Void or Vacuities in it, no empty Space, ſo not capable of being compreſſed or brought into leſſer Compaſs, conſequently no Elaſticity in it, we learn from Experiments likewiſe. Exhauſt the Receiver of all that Part of the Air, which is too big or groſs, or in too large Maſſes, to pervade its Pores, *i. e.* run through the Glaſs, we ſhall ſtill find it *full* of ſome which can; and by the Impulſe of the Hand, readily will; for on Rubbing the outſides of the Glaſs with your Hand, it flaſhes out in Light, which ſhews it was there before, at reſt, ſo not ſhining. Its Parts are contiguous and continuous throughout the Glaſs, otherwiſe the Motion of thoſe next to, and in the Pores of the Glaſs, which your Hand immediately preſſes upon, could not affect the next to them; or they others, till they reach the Eye: And this will be the Conſequence on which Side ſoever of the Glaſs Receiver you rub your Hand. Beſides, you can ſee through the Air-pump, when exhauſted of the Air, *i. e.* of the *Spirit*, which is another Proof of its being full of the Atoms of Light. As you can ſee through it in every Direction, this ſhews that the Atoms of the Fluid in the Glaſs are in Contact in every Direction, and ſo conſtitute a Plenum, as far as the Unites of Light can do. They, indeed, muſt have ſome Size, and ſo you may imagine that they can't touch in all Points, and conſequently, that there may be ſome void Space between three or more of its Atoms; ſuppoſe the Atoms round, and this muſt be allowed; but there can be no void Space wide enough for another Atom to come in among them.

What made ſome People aſſert a *Vacuum*, or that the Air-pump, in the laſt Experiment, and ſo our Atmoſphere, was in a great Meaſure void Space; and the Regions above entirely ſo, (excepting a few *Effluvia*, or a thin Vapour from the Sun, *&c.* * here and there, flying about without any Thing to ſupport it, or carry it on) was owing to their not ſeeing this Part of the Air which no Veſſel can confine, any more than a Sieve can Water; or rather, to their not knowing that this, and the Remainder of the Air were the ſame Species of *Matter*. I ſay, not knowing what it was, whence it came, and whither it went, for they have been forced to acknowledge its Exiſtence. Nay, † *Newton* himſelf aſcribes the Riſe of the Thermometer in *Vacuo* to the Heat communicated by its Vibrations. And if it be the Cauſe of Heat, its Parts muſt touch each other, or elſe the firſt could not move the ſecond, and the ſecond the third, and ſo on to the Wine in the Thermometer. And if the Contiguity and Continuity of a Subſtance ſo fine and ſubtile as to eſcape the Eyes and Knowledge of our learned and curious Obſervers of Nature, ſo far as only to allow by Way of Sneer that this *feigned and imaginary Subſtance* might perform ſome of the Effects the Ancients aſcribed to it; if, I ſay, a Subſtance ſo ſubtile as to eſcape their nice Obſervations and ſharp Penetration, withal whoſe Parts are ſo ſmall as to paſs and repaſs the Pores of any Body whatever, if ſuch a

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* Neceſſe eſt, ut ſpatia Cœleſtia omni materiâ ſint vacua, niſi forte excipiendi erunt tenuiſſimi aliqui vapores et exhalationes vel effluvia quæ oriantur ex Atmoſpheris Terræ, Planetarum et Comætarum. Materia illa ficta et commentitia qua Cœli ſint repleti, nullo modo utilis eſt ad explicanda Phænomena naturæ. *Newt. Opt.* 1706. p. 313.

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† See *Newt. Opt.* 1719. p. 350. Cited Power eſſential and mechanical, *p.* 267. Annon jam Calor ille exterior trans vacuum defertur, vibrationibus medii cujuſdam longe, quam eſt Aer, ſubtilioris; quod quidem medium, exhauſto aere, tamen adhuc in vacuo ſuperſit.

Subſtance doth not make what we call a Plenum, I ſhould be glad to know what is meant by that Word in the preſent Diſpute.

But as our learned Men did not know what this Subſtance was, they called it ſometimes *the feigned and imaginary Matter*, ſometimes *the ſubtile Matter* or *ſubtile Fluid*, laughed at it, and laid it aſide. Whereas it appears a great Part, nay, by far the greateſt Part of created Matter went with them under thoſe mock Titles, and was looked on as nothing, only becauſe Glaſs is too porous to confine it, and they did not know what Buſineſs it, or Air in any Shape, had in the Regions above. That,

Their ſubtile Fluid is Air, the condenſed Receiver puts out of all Diſpute, becauſe grinding *Spirit* between two Stones makes *Light* of it, or makes it ſubtile as grinding Wheat doth Flower, and as Heat melts Bodies.

Obſervations likewiſe confirm this Point, becauſe we ſee Air, in my Language, *Spirit*, flow very faſt into a Fire, and find Light and Heat irradiating as faſt from it, have Reaſon to conclude that what goes in comes out again. As *Spirit*, we ſee it doth not; but ſee it doth ſo in Light or Heat, which paſs the Pores of the Eye or Hand, which the *Spirit* cannot; and ſurely we have Reaſon to ſay, that it doth not enter the Hand or our Eyes becauſe of its Denſeneſs. The

Fire therefore only thins it, or to ſpeak ſtrictly and intelligibly divides or ſplits its Grains or Maſſes; and then it can, as Wheat when ground, run through the Sieve, which it could not before.

So we are as well aſſured that *Light* and *Spirit* are the ſame, as we are that Wheat and Flower are ſo. On theſe common Obſervations and Experiments are founded many uſeful Deductions in Philoſophy.

From hence we learn that the Fire at the Sun and our common Fires are kept up in the ſame Manner, by the Influx of *Spirit* and Efflux of *Light*. And we can't help ſeeing that the Force or Compreſſure, with which the *Spirit*, from a Sphere of ſome Millions of Miles in Diameter deſcends to the Sun on all Sides muſt be incredibly great in Proportion to the Quantity of Matter in Motion. The Draught to ſome of our Fires here is exceſſively great, to the ſolar Fire therefore it muſt be almoſt boundleſs.

From hence likewiſe we learn that one Moiety of the Heavens or Air is continually melting, and the other ſtorkning, condenſing, or growing cold. That as one moves one way, and the other the other, the *Light* from, and the *Spirit* to the Sun, they muſt preſs and drive againſt each other, (all being full, and one Atom not being able to move, till it diſpoſſeſs another of its Place) ſo raiſe an Expanſion, bind and compreſs (and ſo of their other Actions) every Thing within and between them, with a Force equal to that with which they wreſtle againſt each other.

That the Force of this Expanſion is inconceivably great; Exploſions and Tempeſts, Fire, and the Diſſolution of the ſtrongeſt Bodies by Light, ſufficiently determine. Our Bodies do not feel the Effect of this Compreſſion, or rather we are not ſenſible of this Force on our Bodies, becauſe they are framed or fitted to it, as Fiſh are to Water. We feel little or no Reſiſtance from it when we move along, becauſe it ſurrounds us equally on all Sides, counterpreſſes itſelf, and is ſo ſmall, I ſpeak of its conſtituent Parts or Atoms, that it runs through the Pores of our or any other Bodies. The Line of its Atoms is continued quite through us, in all Parts of our Bodies, and we glide upon it, or upon Lines of it which pervade or go through us.

I ſhall conclude this Part with a Citation from one of the greateſt Philoſophers this Age or the laſt hath known. I wiſh the next may be bleſt with his ſecond. "[a] Spi-"rit is preſſed into a culinary Fire and "melted there, becomes Light, and the "ſucceeding Spirit preſſes it outward, ſo at "the Sun. The Light muſt be reformed "into Spirit, elſe the Action would ceaſe. "The Light irradiates to this Orb, and to

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[a] *Power eſſential and mechanical*, p. 223.

" all other Orbs; ſo in every Line from
" Center to Circumference, forms there into
" Spirit (concreted Grains) and is preſſed
" backward in every Line to the Sun. Theſe
" contrary Motions produce an Expanſion;
" that a Compreſſion. The Light and Spi-
" rit are and act upon the Surfaces of this
" Orb; therefore they are and act upon
" the Surfaces of every Orb and every Atom
" of Matter; ſo where the Compreſſure is
" greater or ſtronger on one Side of an Orb
" or Body, than on the other Side, Impulſe,
" ſo Projection, Attraction, Gravity, Elaſ-
" ticity, and all the other Powers they dream
" of are mechanically produced."

It may be thought, perhaps, that this Philoſophy labours under the ſame Difficulty we charge the *Newtonian* with, *viz.* making an Agent of Matter; making it capable of exerting an active Power. When we ſay the Grains of Air preſs upon the Atoms, ſtruggle with, and at laſt overcome them, diſpoſſeſs them of their Place, and are by that Action at the Sun reduced to Powder, Units, Atoms, or whatever elſe you pleaſe to call the conſtituent Corpuſcles, and that ſuch Units adhere again, when got at ſome Diſtance from the Sun, where the Struggle is not ſo immenſely great, cloſe and ſtrong, is it not making them act, giving them a Power of chuſing and going which Way they pleaſe? I anſwer, In the firſt Place, we do not make them act where they are not preſent. That they are in Contact from Center to Circumference, I have already proved; ſo one Part may move another, and ſuch Motion be continued from one Extreme to the other, by putting any Part in Motion, as puſhing a Stick at one End moves the whole. I have likewiſe proved, that *Light* and *Spirit* are the ſame Species of Matter; and that the Spirit really doth expel the Light, purſue and diſperſe it, and that with an incredible Force. And that Light doth reform or turn into *Spirit* again, is a certain Concluſion, elſe all the *Spirit* in the Univerſe muſt long ſince have been melted, and ſo there would have been neither Fire nor Light which can't ſubſiſt without the Action of the *Spirit*. The Matters of Fact then are out of Diſpute. The Queſtion is, how ſuch Power continues. Let us ſtate the Caſe.

God creates Matter in ſmall indiviſible Parts, of which there are a great many Sorts, deſigned to form different Things, ſuch as Air, Water, Earth, and ſo forth, for our different Occaſions, in proper Quantities, and diſpoſed in proper Places, each Sort, where it would beſt anſwer the End it was made for. The Air is created in a vaſt Quantity, diſpoſed in a Sphere, (which, whether it be round like a Ball, or not, I ſhall not enquire,) the Sun in the middle of it, the other Orbs ſwimming in it at different Diſtances. The Air reaches from the middle of this Ball to the very outſide; that part of this Fluid which lay towards the Outſide or Circumference, is made by the divine Power to concrete, adhere in ſmall Maſſes or Grains, which are leſſer and leſſer, the nearer you approach the Sun at the Center, where a great Quantity of the Air is in the Condition I have termed thin Fluid and Light. All now ſtands ſtill, and muſt for ever have done ſo, had not the ſame almighty Hand, which gave Being to all Things, began the Motion, which was done by making the Grains or Spirit deſcend into the Place of the Light, or thinner Fluid. It is plain, that now the Atoms muſt come up in Lines from the Sun, and be preſt in amongſt the Grains at the Circumference, becauſe they have no where elſe to go, and be there ſtopt; ſurrounded by the Grains, and compreſſed or ſqueezed, as in a Vice. Whilſt thoſe Grains which are got downwards to the Sun, and in among the Atoms there, muſt run againſt the Atoms, as againſt Spikes; and by this Colliſion, and the Colliſion in the Pores of the Orb of the Sun, be fretted or rubbed to pieces, ground or melted into Powder, and ſo become *Light*. Thus, at the ſame Time, the *Spirit* becomes *Light*, and *Light* becomes *Spirit*; one at the Center, the other at the Circumference of this Syſtem;

not owing to any Power in either of them, other than what ariſes from their being firſt formed into theſe different Conditions, and made to move againſt each other; ſo the natural Conſequence of the Motion of the *Spirit* was grinding itſelf into *Light*, or being melted into a thinner Fluid, and condenſing or ſtorkning the thin Air or Light into *Spirit* again.

A Grain of Spirit at, or near, the Circumference, is made to come forward; it finds another before it, preſſes upon it, and ſo on to the Sun; but that which is next the Sun, can't move till it hath driven ſomething elſe out of its Place: That *ſomething elſe* here, is the Atoms of Light, which come out in the oppoſite Line, to the deſcending Grain; and cannot one Atom of it get forward, but by driving another before it, and that muſt drive another, and ſo on to the Circumference; conſequently the Motion is in a Circle, and all moving at the ſame Time, from whence the Compreſſure ariſes; for theſe two, moving different Ways, act ſtrongly upon every Thing they ſurround, binding it between them, and moſtly or moſt ſtrongly binding it, where the Grains are largeſt, and ſo leſs able to pervade the Pores, and diſunite the Units the Body conſiſts of. And will they not preſs their own Parts? Muſt not the Effect of the Preſſure be upon itſelf, before it can be upon any Thing elſe? Suppoſe an Atom were preſt in between two deſcending Grains, muſt it not be ſqueezed as if it were in a Vice? in which Caſe it will adhere to them, or be at Reſt, as much as a Piece of Iron in a Vice is: And what is true of one Atom between two Grains, will be true of more Atoms between more Grains, and ſo on to any Number.

I am not endeavouring to ſhew that this Fluid could have put itſelf into Motion, have formed itſelf into Grains, and ſo have continued the Motion; but how the Motion continued, which God begun, when he ceaſed from ſupporting it. And it muſt continue, becauſe the firſt Motion, which God gave the Fluid, both diſſolved or melted the Grains at the Sun, and concreted the Atoms at the Circumference: And the Motion being from Center to Circumference, the Grains muſt come down gradually to the Sun, the Reſiſtance that Way being leaſt. That the Expanſion doth move ſome Things, is proved by ten thouſand Obſervations and Experiments. That it carries a Stone to the Earth, when flung up into it, the Reſiſtance near the Earth being leſs than the Preſſure above it, is in general proved already: In the ſame, or like Manner, the Wind-gun carries a Bullet by the Preſſure of the Air behind, being greater than the Reſiſtance before; this Difference in the Strength of the Air behind the Stone and Bullet, comes from different

Cauſes, it is true, but both are performed by the Air. So two Plain-ſurfaced Marble Slabs are held together by the Preſſure of the *Spirit*, which can't paſs their Pores, or inſinuate itſelf in between their Surfaces: So a Drinking-glaſs is held in Water, when turned upſide down into it, and pulled up perpendicularly. Wherever therefore the Fluid, before any Body is thinner, or its Preſſure by any Means is abated, it will drive the Body that Way: So it muſt bring a Grain from the Circumference to the Sun, the Reſiſtance that Way being leaſt. And as Grains are formed at the ſame Time, there always will be Grains to deſcend, ſo there always will be Motion, which as God begun, the different Conditions of the Fluid are the Cauſe of its Continuance. I think it is very plain, that the Motion muſt have continued, as long as there were Grains to deſcend; and ſince that Deſcent makes or continues a Supply of Grains, there always muſt be Motion.

It ſeems at firſt View, as if we made Matter move itſelf; but whoever will conſider the Caſe, will ſee clearly enough, that the Preſſure, and Expanſion in the Fluid of the Air, muſt continue when once begun, becauſe ſuch Preſſure would move its own Parts, and the Motion of its own Parts is the Cauſe of its Preſſure. This muſt have continued as long as there were Grains to move in one Part of the Line, and Atoms in the other: And by the Contrivance of God, who hath diſpoſed Things accordingly, there always will be ſo naturally.

This is not arguing in a Circle. Theſe Agents act ſo indeed, or in Lines in and out, from Center to Circumference. The ſame Action which grinds the Grains at the Sun, compreſſes the Atoms at the other Extreme; for it is plain, that the Grains by Deſcent come in among the Atoms which are looſe, ſo not able by Circumpreſſure, to hold the Grain together, but let the Friction break them to Pieces. And it is as plain, when a Line of Grains comes down, that many Lines of Atoms (a Grain containing many Atoms, ſome more, ſome fewer) muſt come up, and run in among or between the Grains, and ſo be, as I ſaid, preſſed and ſtopt between them, as in a Vice. And it is likewiſe plain, that when the Lines of Atoms run in among the ſtagnant Fluid at the Circumference, or in among the Grains, that the Grains muſt come from the Circumference downwards or Center-wards, ſince they have no Room to go elſewhere.

I have conſidered nothing but the Preſſure to account for the Adheſion of the Atoms into Grains; but doubtleſs the Form or Shape of the Atoms may contribute to this, or render them capable of being twiſted in with each other, or woven together in ſome ſuch Manner, as the vegetable Matter is, in the Wood, Fruit, Roots, and Fibres of Trees. I pretend not to aſcertain or gueſs at the Size or Shape of the Atoms. They are too ſmall to be the Object of our Senſes; and there is nothing, that I know of, revealed about it: But as they were framed by infinite Wiſdom to adhere together, and that they do ſo, being apparent from Experiments and Obſervations, I ſuppoſe their Size and Shape are ſuited in the beſt Manner to the Uſe they were deſigned for.

We are ſo far from being able by Reaſon, with the Help of our Senſes, to have diſcovered the Knowledge of a Creator, (much leſs of his Will) that the Knowledge of the *Creature* would have been for ever hid from us, had it not been pointed out to us by the Finger of God.

Having now, as I hope, proved by Reaſon, I mean, by common Senſe, that the Cauſe of Motion is not elſewhere than in the Air, and ſhewn from Experiments and Obſervations that it really is there, and alſo explained the Manner in which, or the Means by which this Power is ſupported and continued, without the Imputation of making Matter a free Agent, exert any active Power, or any Power but by Impulſe and in Contact; ſo laid aſide occult Qualities, impreſſed Laws, Virtues irradiating without Means, and the like Jumble of Nonſenſe and irreconcileable Contradictions, we are

next

next to enquire into ſome of the Effects of this Expanſion, ſuch as Gravity, Attraction, Elaſticity, and ſo on, leaving the more minute, ſo more perplexed Actions, ſuch as the particular Sorts of Attraction, and the different Degrees of Elaſticity to the Ingenuity of the Reader, to ſtate the Caſe, conſider the Circumſtances, and ſo be his own OEdipus.

GRAVITY.

Gravity. I have proved that the Compreſſure of the Air (for under that Name I include *Light* and *Spirit*) on all Bodies, nay, on every Atom of Matter, is exceeding great, in all Directions on every Side, and it is agreeable to the Laws of Hydroſtaticks that it ſhould be ſo. We are therefore to conſider the Univerſe as a Sphere, and may eaſily, in Imagination, divide this Fluid into Columns or Lines, extending from Center to Circumference, and preſſing againſt each other, nay againſt themſelves, one part of the Line againſt another, as one part of it is coming out from the Sun, another part going thither, it is then plain, that any large Body, as the Earth, will have theſe Columns tending to, and ending upon it, on every Side; juſt as if you was to ſqueeze any Thing between your Hands, it receives the Preſſure of your Hands all round it: In the like

Manner the Earth laying between the Columns of Air, which ſurround it on all Sides, (the Body of the Earth keeping off the Counterpreſſure of the oppoſite Columns) will be compreſſed on all Sides; and this Preſſure will drive all near-adjacent Bodies to it, and keep them there; and if you throw any Thing up into the Air, will bring it back, and return it to the Earth. And this is what they call Gravity.

Different Degrees of Gravity.

The cloſer the Atoms of a Body lay to each other, ſo the fewer and the ſmaller Pores it hath, the ſtronger Hold muſt the Fluid take of it, becauſe the leſs of it will run through. And it muſt take different Hold of different Bodies, according to the Size and Figure *(cæt. par.)* of their component Particles; and conſequently return them or preſs upon them with different Degrees of Force, thereby cauſing the different Degrees of Gravity, or making one Body heavier than another. So the Weight is no proper Meaſure of the Quantity of Matter in a Body. Suppoſe an Atom, of a Diamond for Inſtance, to be as big as three of the Air; and an Atom of the common Earth, as big as two of thoſe which compoſe the Air; it is then plain, that the Diamond muſt be heavier than the common Earth.

And as every Atom of Matter is preſt upon by ſome Part or other of this Fluid, the Weight of a Body will be in Proportion to the Number of Atoms in it, allowing for the Difference of the Size and Shape of the Atoms different Bodies conſiſt of. And it matters not whether the Surface of a Body be large or ſmall: This muſt make ſome Difference as to the Time it will deſcend from any Height in, but none, or very little, as to its Weight. A large Surface will not let it fall ſo ſoon or ſo faſt, becauſe the *Spirit* underneath ſupports it, it ſwims upon the Spirit in much the ſame as it would upon Water: But put it in a Pair of Scales, and it will weigh as much, and ought to do ſo, becauſe the groſſer Fluid above it hinders its Aſcent, and ſo hinders the oppoſite Scale from weighing it up, as much as the groſſer Fluid underneath doth its Deſcent. So that the Scale finds as much Oppoſition in moving upwards as downwards, and conſequently the Difference on this Account is next to nothing.

The longer the Columns of Air, or the greater the Quantity of Air between two Bodies is, the leſs will they be preſt to each other, becauſe the interjacent Fluid will keep them aſunder, at leaſt obſtruct their approach. And at ſome determinate Diſtance the Preſſure ariſing from hence muſt be next to nothing; as for Inſtance, betwixt the Earth, and one of the fixt Stars, either on Account of its Diſtance or Size. So betwixt the Earth and a Stone moved from it by any Means, the higher it goes, the leſs will it be preſt to the Earth, the leſs its Weight will be, becauſe the Column above it, which drives it down, is more and more reſiſted by that below it, and in its Deſcent to the Earth is leſs and leſs reſiſted. How far this Sphere of Preſſure extends, or at what Diſtance from the Earth it begins, is hard to ſay, but it is plain the Moon is within that Diſtance, and by it tethered to the Earth. And though the different Streams of Light from the Orbs break in upon it, and ſo vary he Force it is tether'd to the Earth by, this t is which keeps it in an Orbit round the Earth. This is what they call its Gravitation o the Earth.

Why the *Spirit* doth not bring the Moon directly to the Earth, and carry the Earth directly to the Sun, is explained at large by he Reverend Mr. *Catcott* in his *Tractatus veteris et veræ Philoſophiæ*. So I need not meddle with it, nor indeed is it before me. And though it is likewiſe foreign to my Purpoſe, I ſhall beg the Reader's leave, as I have done the Author's, to inſert a Method of calculating the Diſtance of the Earth from the Sun by its diurnal and annual Roation. This Method, which we are obiged to the Reverend Mr. *Walmſley* of *Angnoring* in *Suſſex* for, brings the Matter o a very great Degree of Certainty, and goes upon this Poſtulatum, that the Earth turns round as it goes forward, as a Coach-Wheel or a Bowl does. This taken for granted, we ſay the Diameter of the Earth is in round Numbers eight thouſand Miles, ſo the Circumference twenty four thouſand; then the Segment of the annual Circle, which it deſcribes in one Day, will be ſo many Miles, which multiplied by three hundred and ſixty five, the Days in the Year, gives the Circumference of the *Magnus Orbis*, the Length of the circular Line it makes round the Sun in a Year; that divided by ſix gives the Diſtance from the Sun. They ſuppoſe the Earth ſometimes nearer and ſometimes farther from the Sun; be it ſo, that is eaſily aſcertained. An Ellipſe is almoſt as eaſily meaſured as a Circle.

This Method of the ingenious Gentleman above makes the Diſtance about a Million and a half of Miles, which brings it far nearer to us than our Philoſophers have done of late; but as they have made ſo many and ſuch different Calculations on this Head, no two agreeing with each other, nay, the ſame Man ſcarce agreeing with himſelf at two different Times, it gives room to ſuſpect they have not as yet hit upon the right Method; and another is at Liberty to offer his Opinion. But to return.

What I ſaid with regard to two large Bodies, as the Earth and Moon, will hold likewiſe with regard to two ſmall Bodies, nay, *Adheſion.*

wo Atoms, but then they muſt be nearer
ach other; and the nearer the ſmaller they
re: Bring them very cloſe, and the Circum-
reſſure will hold them together. So two
oliſhed Plains adhere very ſtrongly, when
here is little or no Spirit between them, or
oom for it to get between. Water makes
me Bodies adhere which will not when
ry, becauſe it keeps the *Spirit* out of its
ores. Nay, ſome ſuch Bodies adhere
rongly when dry again, the Water being
xhaled; and the ſtronger, the ſlower they
ry, becauſe the Grains of Air being vaſt-
different in Size, the common Preſſure on
l Bodies drives the ſmaller in by Degrees
rſt, and the larger, which can't enter, bind
round: Whereas if the larger get in firſt,
hoſe within reſiſt as much as the other bind
ithout, and ſo keep the Atoms of the Bo-
y diſunited from each other. Beſides, wet
odies drying leiſurely, their Parts are brought
loſer and cloſer together, as the Water gets
ut. And this is the Attraction of Adheſion,
hich, as they ſay, acts at very ſmall Diſ-
nces, and exceſſively ſtrong in Contact.
nd why may not Air be ſuppoſed capable
f holding the Parts of Bodies together, as
ell as Water, Vinegar, Spirits of Wine,
nd many other Things, by which we pre-
rve Fruits, Herbs, Fleſh. How is it they
eſerve Things, and prevent their Diſſoluti-
n, and make them adhere! Is it not by

ſurrounding them, and keeping off wha would enter, and, like a Wedge, tear them to Pieces? The Air is in the Pores of all Bodies, ſome part of it capable of entering any Thing; and its Parts are always endeavouring to take Place of each other, the Grain of the Atoms, and the larger Grains of th ſmaller, as obſerved before, ſo by continua Friction, will, in Time, tear almoſt an Body to Pieces; and if any Thing ſurroun the Body, and prevent the groſſer Air coming at it, or prevent the *Light* and *Spiri* changing Place in its Pores, it will preven its Diſſolution.

If you aſk why one Fluid, ſuch as Water, ſhall diſſolve, and another, ſuch as Spirits of Wine or Vinegar, preſerve the ſam Body, I aſk again, why a larger Wedg ſhall ſplit what a ſmaller will not; and ſmaller enter, and ſo ſplit, what a larger wi not enter, ſo not ſplit? Thus Water ſha melt Sugar, much ſooner than Brandy. W have ſhewn above, that the original component Parts or Atoms are different in Size Whence it follows neceſſarily, that the Pore in Bodies, conſiſting of a different Species o Atoms, muſt differ in Size: Hence the Atoms of Water, *e. g.* are adapted to th Pores of one Body, and not another, an ſo give the Air an Opportunity to uſe it as Wedge to tear aſunder the Atoms of a Body which Vinegar may run through; and o

he contrary, Vinegar may be adapted to
he Pores of Iron, for Inſtance, which Wa-
er will not ſo ſoon enter. *Aqua Fortis* to
ilver, but not to Gold, without the Addi-
ion of Salt, by which the *Aqua Fortis* may
ct upon the Gold; ſo the Air preſſes the
qua Fortis, that the Salts, and they enter
he Pores, widen them, and diſjoin the
toms, that is, diſſolve it. Nay, Water
vill, when Force is applied, open the Pores
ven of Gold ſo far as to make a Paſſage for
tſelf, as appears by the *Florentine* Experi-
ment mentioned by Mr. *Locke*. So Quick-
ilver ſhall diſſolve you Lead in an inſtant.

Nor muſt we forget what Alteration the
ifferent Figures of the component Particles
muſt neceſſarily make in ſuch Caſes. We
an but gueſs at the comparative Sizes and
Figures of the Atoms different Things con-
iſt of; but in general it muſt be allowed,
hey do differ, and then my Conſequence
neceſſarily follows that this or that Fluid will
iſſolve one Body and preſerve another; and
hat the Air whoſe Atoms are ſmaller than
hoſe of any other Body, but whoſe Grains
re of various Sizes, and ſo ſome of
hem bigger than the Units of any other
Body, will in different Circumſtances pre-
ſerve and diſſolve, hold together or tear
aſunder any Body whatever, make uſe of
ſome Sorts of Matter, as Wedges to cleave
with; lodge others in the Pores, and pre-

vent internal Fermentation, which alway diſſolves ſooner or later.

Thus Flame, which is kindled Smoke, ſeems to conſiſt of larger Parts than a Spark, and accordingly is not fine enough to ente the ſmall Pores of Charcoal, when filled with Spirits of Wine, Nitre, &c. (Gunpowder) ſo will not fire Gunpowder as Spark will; and Heat, which is ſmaller than a Spark, will diſſolve the *Lapis Fulminans*, which a Spark will not. And let me add tha Bodies are more or leſs fitted for Diſſolutio as they are compounded of different Specie of Atoms. But it would be an endleſs Wor to ſtate all the Caſes of this Nature, it i only my Intent to account in general for th Operation, in order to prove the Agent, or prevent Objections againſt what I think is proved, leaving Particulars to better Heads. Nor is there any more Neceſſity for me to d ſo, than for him who accounts for ſmelling by Effluvia, to ſhew why the Smell of one Creature is agreeable, and another diſagreeable; why, for Inſtance, the Smell of a Mouſe ſhould be grateful to a Cat, when that of the Cat is ſo highly offenſive to the Mouſe, and ſo for other Smells. Who is there can ſee ſo far into the Conſtitution of the Noſes of theſe two Animals, and the Kind of Effluvia which come from each, as to determine this; and yet who Doubts but the Smell is the Inſtrument by which one is led to hunt its Prey, and the other to avoid its Foe. So a blind Puppy is led to the Teat of its Dam; not by Reaſon, Knowledge, or the Impulſe of any Superior Agent in or without it, but by Smell of the Milk, which Nature hath provided for its Support, but *why* or *how*, I mean not as to the final but efficient Cauſe, it is impoſſible we ſhould ſee, unleſs we could ſee the Atoms which compoſe the Milk, and the Atoms and Structure of the Atoms which compoſe the Creature's Noſe.

Projection.

Make the Air thinner (we underſtand one *Projection.* another, I hope, by this Time, and know what we mean by thicker and thinner) make the Air thinner on one Side of a Body than the other, and it will be carried that Way immediately. Thus jirk a Stone out of your Hand, it drives the thicker Air before it, and leaves a Track behind which is thinner, into which the *Spirit* immediately ruſhes like a Current, and drives the Stone before it, till the Mixture becomes equal again. The quicker you do this, the ſtronger will be the Impulſe on the Stone, becauſe the leſs Time hath the lateral Air to preſs in and fill up the Vacancy, ſo prevent the Spirit behind from purſuing it. Confine the *Spirit* in any Veſſel, by condenſing it, as they call it, on giving it ſudden Vent, it will carry what lays in its Way, as is the Caſe of the Wind Gun. Thin or ſplit the Grains of Air by Fire, as by Gunpowder in the Barrel of a Gun, or Creviſe of a Rock, and the Force the *Spirit* preſſes in with, and carries the Ball, and Parts of the Rock with, is beyond Imagination. Nay, it is a ſurpriſing Weight which Light will lift, when confined for a ſhort Time, as in the Cylinder of the Fire Engine, by Water riſing in Steam and ſtopping the Pores of the cylindrical Veſſel *, and this is Projection.

Under this Head comes that Species of Elaſticity by which a Body rebounds. Throw a Marble out of your Hand againſt a Marble Slab, and it rebounds back again. The fall of the Marble doth the ſame, as a Stone when projected, ſeparates the *Light* and *Spirit* in that Line, on which a Current of *Spirit* purſues it to the Slab, can't go through the Slab, but is beat back, and aſcends, and brings the Marble up with it by the ſame Means it carried it down: And this ſeveral Times till the Mixture becomes equal. "*But* "*why doth not all Bodies rebound equally*; *or* "*why doth not a Marble rebound equally from* "*all Bodies?*" I aſk again why all Bodies are not Solids, or all Fluids? Doth not that depend on the Difference in the Atoms which compoſe them? So doubtleſs doth Elaſticity in ſome Bodies; at leaſt the different Degrees of Elaſticity. Though the Surface of the Body is to be conſidered here. A ſquare Body doth not rebound like a round one, which it ought if Elaſticity were a Quality inherent in the Subſtance. Here the Caſe is plain, a flat Body falling on a flat Surface touches in too many Points for the Spirit to get in between to ſeparate them again, but returns without it; whereas a round Body gives the Spirit Opportunity to come under and bring it up again: It gets between the Marble and the Slab, and ſo between two round glaſs Balls, when let fall againſt each other, becauſe they touch in but one or few Points. If the Spirit pervade the Body the Marble falls upon, it doth not return, and then there is nothing to bring the Marble back or up again; it hath carried the Marble down, and gone on beyond. This is the Caſe if you drop a Marble upon the Earth. Upon a ſmall Point of any Thing. Upon Water. Upon any Thing ſoft which gives Way. And its Rebounds are more or leſs ſtrong, as the *Spirit* which carried it down returns in a greater or leſs Degree, and takes hold of the elaſtick Body in its Return. Two glaſs Balls rebound from each other in *Vacuo*, as it is called, for the very ſame Reaſon as in the open Air, becauſe the leſſer Grains and Atoms there change Place with each other, as the larger and leſſer Grains do in open Air.

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* *See* Glory Mechanical, *p.* 70, *et ſeq.*

Make the Air thinner between any two Bodies, and they will be driven together. Thus, rub Amber, Wax, *&c.* and the Friction diſſolves the ſmaller Grains in its Pores and near it, and thereby the adjacent thicker Air will preſs to it, and carry ſmall light Bodies (whoſe Pores the thinner Air, which comes from the Wax, can eaſily paſs, and whoſe Weight is but ſmall) up to it, and keep them there. So the Load-ſtone and Iron, when placed near each other, are forced together by the Air behind each of them. Its Atoms are flat, if one may judge from their laying in Flakes, as is viſible to the Eye, and thereby give the Air an Opportunity to run through (I mean the ſmaller, finer Part of the Air to run through) its Pores, in one Direction chiefly, from Pole to Pole, as it is termed, in Lines parallel to the Horizon, like a Draught through a Paſſage, when the oppoſite Doors are open. The Iron is formed in almoſt the ſame Manner, only not ſo cloſe and compact, as the Load-ſtone; by this Means the Space will be always thinner between them than on their Backs, and conſequently a Preſſure will always lay there; and this Attraction be performed by Impulſe in the ſame Manner, and by the ſame Agent, that all the other Operations of Nature are. It is the Size and Shape of the Atoms, and Direction of its Pores, which occaſions the Air to act ſo dif-

ferently

ferently upon it, than it doth on moſt other Bodies. That it is no Quality inherent in the Stone, annexed to the Subſtance of it, I think, from common Senſe, admits of no Diſpute, becauſe then the Stone muſt act where it is not preſent; a Power, which they have had the Aſſurance to ſay, that *Jehovah* themſelves are not endued with, and ſurely they will not give it to Stocks and Stones. But that it depends upon the Preſſure of the Air, as all other Motion doth; and the different Effects that Preſſure hath upon this Stone, from what it hath upon others; that theſe depend upon the Texture and Form, taking in the Size of its Parts, is beyond Diſpute; becauſe Fire takes away its Virtue, which it could not do, without taking away its Subſtance, were it in the Subſtance. "*But it communicates this Virtue to* "*a Knife or Needle, when touched by it.*" It doth ſo, if you move the Knife in one particular Direction. We ſuppoſed a Draught through the Stone, owing to the Texture of its Parts; and if you lay your Knife on the Stone in *that* Direction, the Air that preſſes through it muſt paſs through the Knife likewiſe, and ſo make the Direction of its Pores the ſame, or nearly ſo, as the other's is, by which means it will attract likewiſe. Rubbing your Knife the contrary Way on the Stone rectifies the Alteration made in the Poſition of its Parts, and ſo

takes

takes out, as they word it, the Virtue which the Touch of the Load-ſtone had communicated to it. Frequent touching ſpoils the Blade of your Knife, which is Proof ſufficient that the Texture is altered, the Adheſion weakened, ſome Parts, perhaps, carried off, and ſo the Knife made more brittle, porous, and not capable of ſtanding to, or keeping ſo fine an Edge. How the Parts of this Stone came to be ſo framed, as to make it capable of being ſo acted upon, with many other Particulars about it, would be too long, too intricate, and is too nice for me to deſcribe, it is done at large by Mr. *H.*

Elaſticity. The Recoiling of Steel Springs, and many other Bodies, which they call Elaſticity, muſt depend likewiſe upon the Size and Shape of the Atoms which compoſe the Body, and on their Texture. Suppoſe the Particles of Steel to be flat, or by their Texture to lay in Flakes, (which, as obſerved juſt above, we ſee they do) drawing together the two Ends of a Bit of Steel widens the Pores on the Back, lifts the Atoms or Flakes farther from each other on the Outſide, and brings them nearer together on the Inſide, ſo that they ſtand more Edgeways than they did before ; the flat Surfaces which lay parallel to each other, and cloſe together, now making an Angle, like the Legs of a Pair of Compaſſes when they are opened, therefore their Adheſion brings them back again into their old Situation, I mean the Cauſe of their Adheſion, the Preſſure of the Air, which is greater on the Outſide than the Inſide of the Atoms. Suppoſe the Compaſſes to be held open by your Hands againſt ſome Force, which ſtrongly attempted to ſhut them, it is plain, that when your Hands are taken away they muſt ſhut again. Two Atoms, which we will call the two Legs of the Compaſſes, are ſtrongly preſt upon by the Air on their Outſides, (however the Adheſion of the Parts of Steel is very great,) on forcibly opening them, or making them make an Angle, as the Legs of the Compaſſes do, you act againſt the Preſſure upon them, but it ſtill lays upon them; and when you ceaſe to hold them open, that Preſſure will bring them together again: By which Means, the Steel, which you held bent with your Hands upon it, is ſtraightened again; every two Atoms being acted upon in like Manner. If,

You aſk, how I know the Preſſure of the Air is ſtill greater on the Outſide than the Inſide of the Atoms of the Steel, whilſt I hold it bent; I anſwer, it appears indiſputably to be ſo, becauſe the Atoms adhere notwithſtanding, which they would not, nor do, when you bend any Thing ſo far as to diſjoin the Atoms, *i. e.* break it. I here take it for granted, that Adheſion is owing to the Preſſure of the Air on the outer Surfaces of the Atoms which Bodies conſiſt of; and therefore here are two oppoſite Forces to be conſidered in Elaſticity; the Force which bends the Steel, and the Force which keeps its Parts together; this latter is conſtant and continually upon it, the other is occaſional; and if you do not bend it ſo far, as to ſeparate the Atoms from each other, and let the Air in between them, thereby making the Reſiſtance between them equal to the Preſſure on their outward Surfaces, why it is plain, that when you ceaſe to hold it bent, that the Preſſure, which is the Cauſe of the Adheſion of its Parts, will force them into their old Poſition, and reſtore it to its former Figure.

If you aſk why all Bodies are not elaſtick, I ſay, all are in a greater or leſs Degree, *i. e.* the Atoms of all Bodies do adhere to ſome Degree or other; and if you raiſe one Atom from another, ſo as not to put them entirely out of Contact, the Cauſe of their Adheſion will bring them back again into their old Places; not equally in all Bodies, all are not equally elaſtick; becauſe the Texture of all Bodies and the Atoms of all Bodies are not the ſame.

If you put Steel in the Fire and burn it, the Elaſticity is loſt, it becomes brittle, and more eaſily broke: Whereas if this Virtue were innate, or ſuperadded to the Subſtance of the Steel, nothing could take it away, which did not take the Subſtance away. And this ſhews that its Elaſticity depends upon the Form and Contexture of the Atoms, whereby the Air can act upon them differently than on Atoms of another Shape, and of a different Contexture. The Elaſticity of the Air, as they nick-named its expanſive Force, I need not mention here, the Reader hath ſeen it before.

Explain the Terms Rarefaction, Fermentation, Suction, and ſo forth, and the Manner, and Means of thoſe Operations will ſhew themſelves.

Thus I have attempted to give the Reader, in as few Words as I could, ſome of the Reaſons which induced me to think that there are *mechanical natural Agents*, by which the Operations of Nature are performed; and, of the Manner in which, I think, they act; the Means by which their Power ariſes, and is continued; and which have determined me in Favour of Experimental Philoſophy, in Oppoſition to occult Qualities, Sympathy and Antipathy, or Attraction and Repulſion. A *Vacui Fuga*, and the like Cant, unmeaning or fallacious Terms, fortified with all the Skill of Mathematicks, and rendered inacceſſible by the Magick Circles they have encompaſſed them with. In ſhort, every Man of common Senſe muſt ſee, that the Proportions of Circles, Figures, *&c.* have no Connexion with, or Relation to, the Cauſes of Motion; and becauſe different Circles bear ſuch or ſuch a Ratio to each other, that therefore the Force with which the natural Agents act muſt do the ſame; and this being allowed as a Proof that there are *Powers* inherent in Matter acting without Means, are two too large Steps for an honeſt Man in his Senſes to take.

If this ſhould fall into the Hands of any Man of Senſe and Candour, who ſhould differ in material Points from me, I ſhall take it as a Favour if he will oblige me with his Reaſons, to which I will either ſubſcribe, or if deſired, let him know why I do not. In the mean Time, I ſhall look on Experiments as the only Method of giving People *ſenſible* Proofs in Philoſophy, and that I have argued right from Experiments.

FINIS.